WWF Memo: Shell's Econometrix shale-gas study

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Pre-amble

Following its preliminary review of the Econometrix economics study on shale-gas, WWF-SA is of the opinion that the study is speculative and designed to play-up the contribution of shale-gas with questionable assumptions of the size of the resource and its economic spin-offs - and without consideration for the social and environmental costs. The report has three major flaws.

Firstly, it doesn't indicate how it came to a well-head price of $8/million cubic feet (MCF) which is not the same as the end-user price. The methodology for arriving at this number is rather mysterious as it isn't evident if it includes the cost of environmental mitigation and other costs or not. The report needs to transparently unpack these factors to demonstrate how the well-head cost is arrived at. The entire edifice of the report sits on the basic assumptions made about well-head and other costs.

Secondly, even if a well-head price of $8/MCF was assumed as being a reasonable price, the study does not take into account market, infrastructure development costs and surcharges for distribution. Adding these costs to the $8 would indicate a truer end-user cost. As it is, these costs would have to be defrayed either by consumers or the government.

The report is disingenuous and deceptive as it describes Shell's handsome turnover, but says little about what the end user will pay or suffer. These end user figures would indicate, at certain price ranges for different uses of gas, the level of market absorption and rate at which people might switch to gas. The cheaper it is, the more likely is greater market penetration and local beneficiation. The higher the price, the less likely it would be that the shale gas market could compete with energy sources.

The final flaw in the report is its failure to recognise that, if huge amounts of capital for infrastructure and storage are required, resulting in long lead times to develop the local market, Shell and other gas producers will be incentivised to export gas. In the event that large reserves are confirmed, dollars will flow, strengthening the rand and potentially destroying local exports and jobs.

Detailed analysis

Introduction

It is always useful to have numbers put on the table and this is what we have been asking for, for a long time. However, the devil is in the detail, as they say. WWF has reviewed the Econometrix study. We believe the report overplays the upside and underplays the downside. It exaggerates jobs figures on the basis of a hunch.

The report is a biased report because it supports Shell's and the industry's overall position to over-promote shale-gas while creating the semblance of objectivity. The report should have at least

presented good case scenarios with worse case scenarios which it does not do. Hence, its credibility is more than suspect.

Instead, it presents the most optimistic case with a great deal of hyperbole which makes it hard to judge the merit of the report and economic analysis presented. An objective report would at least spell out the pros and cons as honestly as possible. On this account the Econometrix study is disappointment.

Nonetheless, we accept that this is yet another salvo of 'evidence' that shale-gas will pave South Africa's road to prosperity with gold. We still believe that proper independent studies are necessary so the public understands what we are in for and what the trade-offs are of having sunk-costs into shale-gas versus other options. We don't believe the economic case for shale-gas really exists. There are many holes in the Econometrix study that would put in doubt the robustness of the study done on behalf of Shell.

<u>Specific points</u>

WWF's substantive concerns with the Econometrix study include the following:

1. The report makes the continued assumption that fracking is a low-carbon solution but provides no real evidence that this is the case. It is fair to say that at present the issue is unresolved and that more scientific research needs to be done. However, WWF would contest, on intuitive grounds, that conventional gas and shale gas would have the same carbon footprint equivalent. Far more energy and effort is required to produce shale-gas compared to conventional gas. We would prefer that science dictates the final verdict rather than guesses from both sides, especially when the institution of a carbon tax on fossil fuels is likely to change the economic case for shale-gas. This has not really been imputed in the Econometrix study;

2. The proposition that shale-gas is a low-carbon option is a result of that the fact that the report recurrently confuses and conflates shale-gas with conventional gas. The two are different and require different techniques and approaches for extraction. We therefore take issue with the way the report conflates shale-gas production with conventional gas production as it only contributes to public confusion and overplays the merits of shale-gas. We can only assume that this is because the report writers themselves are confused or that this is a deliberate attempt to miscommunicate the merits of shale-gas compared to conventional gas. The costs of extraction for shale-gas would likely be dissimilar to conventional gas given the different intensity levels involved in the production of the two different sources of natural gas.

3. The study has not undertaken a cost-benefit analysis of conventional gas supply from neighbouring countries and compared it to the sunk costs that would be incurred for domestic sources of shale-gas production and supply. Such an analysis would demonstrate the economic trade-offs and opportunity costs involved in supplying shale-gas to the domestic market versus sourcing supply from a neighbouring state. Incurred costs would vary according to geographic location. It is therefore disingenuous for the Econometrix report to underplay these variables. A fair comparison is needed to justify the economic rationale for sinking additional public funds into a shale-gas endeavour when other options may be less environmentally damaging and more cost-effective.

4. One of the report's flaws is that it varies in the way it draws on sources for its findings from hard-core analysis to op-ed commentary thereby reducing the legitimacy of some of the findings as op-ed conclusions need to be subject to some rigour if one wants to use them as legitimate findings and sources of economic analysis. To say that there are 400 years of crude oil equivalent of oil supply from shale-gas, based on the opinion of Brian Kantor, can be easily dismissed because the report admits that the resource estimate remains to be 'proven'. Using Kantor's opinion without having proven economic viability of reserves should caution us not to throw numbers into the public arena with the intention of stirring up the stakes for shale-gas. Since the resource and reserve estimates need verification, the report should rather not punt figures when the actual resource estimates remain uncertain. Such claims suggest the study to be more of a public relations exercise than science or proper economics.

5. To illustrate: in the US, for instance, in January 2012, shale-gas estimates for unproved technically recoverable shale-gas was downwardly estimated by close to 50% from 827 TCFs to 482 TCFs. The Marcellus shale-gas fields were down-graded from earlier estimates of 410 trillion cubic feet (TCF) to 141 TCF, with US geological survey estimates being even lower – at around 84 TCFs. All of this is important because it influences assumptions about economic benefits and the number of jobs that can be created from the extraction of shale-gas. As a consequence, in the US, a debate is currently raging as to the true picture of shale-gas estimates. Optimists put shale-gas figures to 100 years or more while the skeptics suggest it may only be close to 23-35 years.

6. Shale-gas estimates prove to be notoriously fickle for number crunchers and it is better to exercise caution than too much enthusiasm when estimating the possibilities of shale gas. As the US story demonstrates, resource and reserve estimates are reviewable. They are not permanent fixtures. Every fossil fuel on earth is recurrently having to have their resource and reserve estimates revised. For instance, coal estimates for South Africa are going to be revised from the earlier over optimistic estimates of 200 years supply to something much lower – certainly less than 100 years when the Council for Sciences completes its work soon. As the Econometrix report notes, there is no cheap coal, and the same may be said for shale if the sums are done properly. Nonetheless, most estimates follow a trend of downward estimation rather than upward. We don't see why this won't be true for shale-gas, orwhy higher estimates are being punted when the truth of what is below the ground is still an unknown.

7. Shale-gas estimates are most vulnerable to revisions because of the geological formations in which shale-gas is to be found in. Geological surveys indicated the unpredictabality of these formations to produce shale-gas. They are at best probabilistic and are prone to error. The science of estimation is an imperfect one. A resource estimate is not the same as an economically viable reserve. The economic viability of the reserve is less likely to change given the higher decline rates and lower productivity of shale-gas wells compared to conventional gas. Decline rates can vary between 50% and 80% per well within the first two years over a reasonable life-span for a well of five years. The estimated ultimately recoverable (EUR) figure for shale-gas extraction is a truer reflection of what is economically viable. This is hard to determine without drilling and figures can only be relied on based on what the experience is in the US at the moment. As US experience shows, this is better estimated after initial shale-gas production (IP) and is most likely to vary from area to area because of the geology of shale-gas. This is a big unknown factor and, since it can only be known once numerous wells have been drilled, but it

would be too late to reverse a decision if production investments are already committed to shift such investments to better options or sources of energy.

8. Resource and reserve estimates are important because they tell us how long a particular energy resource will last. The Econometrix report for instance refers to the estimated risked recoverable resource as a reserve. This confuses the issue. Standard definitions distinguish between resources and reserves with reserves being 'the probability of gas existing and being producible under current economic conditions using current technologies'. It is important that expert reports not confuse the hypothetical with the real. Reserve estimates in the end will tell us how infrastructure costs and other costs can be covered over the life-span of gas production. If the reserves don't last that long it means infrastructure costs will have to be borne by tax-payers. This is a big risk with shale-gas because it is located in areas distant from the major economic hubs and so makes the economics of defraying present and future costs of infrastructure somewhat challenging;

9. In the case of shale-gas, reserve estimates are a challenge because of 'interference'. The general rule of thumb for conventional natural gas productivity is between 50% and 80%. This however, is not the case for shale-gas. Estimates in one area or location can inflate estimates for nearby areas and hence the problem of over-statement. As Michelle Foss from the Centre for Energy Economics, at Texas University noted; "The bane of unconventional resource plays is exactly the battle against declines". Or, as she further noted; "Below-ground geological uncertainty coupled with substantial above ground risks makes the business model for commercialising unconventional resource plays difficult". The government will therefore have to make important public spending choices because gas flushed from deep beneath the earth requires different sorts of infrastructure to support the industry. This infrastructure has to be invested over time and gas extraction will have to pay these sunk costs [1]over time. As overseas examples demonstrate, tax-payers will end up paying out of their pockets if shale-gas production does not follow the promise. There is a potential risk of stranded infrastructure and this issue needs to be looked at more concertedly against other options. This area of concern is not really well thought-through in the Econometrix study.

10. Expert opinion suggests that in the US drilling costs are currently going up, while well productivity is rapidly depleting.[2] The consequence is that wells have to be refracked several times amplifying environmental risks, water consumption and energy consumption. The Econometrix study's flaw is that it is not based on accurate estimates of well behaviour and productivity. For every trillion cubic feet that is estimated to be available there is a proportional decline rate that needs to be factored in. For every extraction effort to improve well productivity,

1 Foss, MM The Outlook of US Gas prices in 2020: Henry hub at $3 or $10, paper done for The Oxford Institute for Energy Studies, December 2011.

2 See Gornictwa, (2010) A Unconventional Gas in the US, Archives of Mining Sciences, Volume 55 No.1

there will be an additional cost surge to fully exhaust gas extraction from each well because the decline rates are high. We consider the inability to build scenarios of different decline rates (meaning drop in productivity of wells) into the resource estimates to be a serious flaw in the Econometrix study and will most likely change the resource estimate and its economics.

11. In addition, based on what is evolving in the US, environmental mitigation costs are likely to go up because of increased pressure to improve environmental enforcement and regulation. It is likely that cheap shale-gas is going to go through a bust rather than boom period because of industry's discounting of environmental costs for so many years. For instance, environmental mitigation costs might reflect very differently if the following environmental standards needed to be met;

a. If there were tough regulations on how wells are constructed, increased inspections with penalties if they are done badly;

b. If waste water had to be cleaned and recycled, rather than dumped in ponds where leakage problems can occurred, or if it had to be injected into permanent reservoirs (this is fraught with problems);

c. If more stringent requirements dictated that gas be captured from the top of the well to cap the level of methane escaping the wells.

The report needs to take a more robust approach to the inclusion of environmental externalities.

12. While the study makes good and salient points about coal-fired power stations needing a lot of water, it fails to acknowledge with any seriousness the amount of water required for fracking. The availability of this water, its disposal and the sensitivity of the recharge rate of groundwater aquifers to low rainfall patterns makes water a precarious resource in the Karoo. Fracking is not a once-off affair. If well productivity is low there would be a need for several rounds of refracking, which will add to the volume consumed and the resultant costs for water supply changing the economics of shale-gas. Fracking discharges a great volume of water below ground with close to 20% or so of the volume returning as contaminated flow-back with gas and other material. Even if options for sea-water or recycled water are considered they would change the economics of supply and would have to be a serious consideration despite the argument that open-cycle gas turbines don't need that much water. This has hardly been the issue but water for fracking has be the consistent refrain of environmentalist and other experts. It is one of the reasons industry is spending inordinate amounts in identifying alternatives to for water but none so far has proven economical or with same levels of efficiency.

13. The study's other key flaw is that, in fixing the well head cost to determine total economic turnover, it misses the fact that a significant proportion of cost crucial for determining market development and access for shale gas would most likely be carried by consumers. Final cost would determine the extent of shale gas penetration in the South African market and hence additional value add through job creation and lower electricity prices. But this is a big assumption to make without modelling different price scenarios and market penetration levels to come to more realistic job and other benefits. The entire report's estimate of economic spin-offs rest on a false end-user price and distorted assumptions about shale-gas market penetration;

14. The study does not indicate how it came to a figure of $8 per million cubic feet (MCF) as the benchmark price. It would be useful to know the nature of the various factors that contribute to the benchmark well-head price that the report uses. This seems rather arbitrary. Econometric studies should have reasonable cost and sale price scenarios to ensure robust analysis and sensitivity test. The Econometrix report fails on this score as it puts a price on shale-gas without substantiation as to how it arrived at this. A reasonable set of scenarios for econometric studies should be ranging from low, middle of the range and high price scenarios – anything from $5/MCF-$17/MCF. They would tell us different stories of viability and cost-effectiveness of consumers. As far as costs go it would be interesting to see what the exploration and production cost assumptions are, capital cost assumptions (interest payments and other costs associated with borrowing or investor requirements), infrastructure costs assumptions in terms of what needs to be built, when and how much, the assumptions behind mitigation costs because benchmark environmental standards for South Africa, specifically for shale-gas, don't exist as of yet, and what the land leasing and royalty costs look like to justify the project estimates at $8/MCF. It is also unclear from the study as to whether the $8/MCF figure being quoted is a static or variable figure, how it will vary over time because exploration and production costs are unlikely to be static and how these prices would affect the Integrated Resource Plan's price path.

15. The threshold point for the economic and financial viability of shale-gas wells is in the range of $6 to $7 dollars in the US. These are under US conditions and we would be hard-pressed to use that as a benchmark threshold figure for unconventional gas extraction to be economical. The report should have taken variant economic threshold prices for well-head costs from different parts of the world, if they are available, and make an educated estimate for South African shale-gas conditions. The report's methodology shows no curiosity or effort in this direction and simply self-selects a threshold price which it then uses for modelling outcomes. The challenge is not turnover and growth for Shell, but affordable well-head prices/costs for South Africans. The report should really turn this on its head. What is the threshold price that is within an affordable range for different types of users of gas in a future gas market for South Africa? This still remains an outstanding question.

16. It is erroneous to capitalise on power black-outs by suggesting that shale-gas offers a ready solution. Even if shale-gas were viable it would be nine to 12 years before it reaches full market potential and application for power generation. In the mean-time power shortages will persist and can only be filled with quickly deployable technologies such as renewables. This seems to be the most feasible and expedient option given the long lead times for other base-load power solutions. Exploiting the energy poverty gap is a publicity ploy which has no real meaning in the context of the long lead time involved in the development of shale-gas. It is more likely that other off-shore gas solutions may prevail and need to be looked into. But these too may be fraught with challenges and difficulties in securing long-term supplies. Nonetheless, they should be looked at more closely than the study attempts to do.

17. For the jobs profile to prevail, the gas market will have to be fully developed. There are four main uses: power generation, industrial use, transport and residential. The inter-relationship, growth and dynamics between each will determine the overall market size. All have their own complications and the overall economic viability and value per GDP of shale-gas will depend on the evolution of the four different markets. They will all require one type of infrastructure

investment or the other from gas-fired power stations, pipelines, storage facilities and household distribution networks. The viability of each is dependent on economies of scale. As the report notes, upstream beneficiation is a function of strong domestic market versus preference for exports. Domestic demand can only be driven by cost-effective or affordable end-user pricing which is not a certainty with shale-gas. Nonetheless, currently the South African mining and extractive industries that are mature, diverse, developed and have low beneficiation, employ about 500 000 people directly and close to another 500 000 indirectly. For an immature and undeveloped gas industry, the direct and indirect job contributions in the Econometrix report seem rather inflated given the fact that market penetration remains an open-ended question.

18. Greater exports reduce the potential for domestic beneficiation. The assumptions behind the jobs numbers in the Econometrix report are heavily reliant on the evolution of the domestic market. The report presents very little detailed breakdown of direct jobs created in the different phasing of shale-gas growth and what assumptions lay behind the multiplier effects for every job created by shale-gas production. It is hard to verify if the assumptions being made in the report are valid or not. But a lot depends on the extent to which shale-gas beneficiation is deepened in the South African economy. This is the critical assumption and if you want an assumption that stands on a less than solid foundation of “ifs” and “buts”. The general record for beneficiation is rather dismal for resource rich countries and one only has to look at other oil and gas producing countries in Africa to note that the export bonanza is exuberant, as well as rewards for a few, but very little pleasure of benefits for the many. Increased levels of domestic use imply increased enterprise activity and employment all of which contribute to the state coffers through taxes. But this is all well and true if the various scenarios in the report hold. For now they are unconvincing because the report merely gives aggregate figures and no more detail to chew on;

19. The South African market is immature and requires long lead times, infrastructure investment and market development. The US for example, has had gas infrastructure since the 1920s. It is much easier for shale-gas plays to lock-in into an existing infrastructure network than it would be in South Africa. Infrastructure will have to be built from scratch in South Africa, the viability of which is really dependent on the reasonable assurance that gas supply will be a sure bet at the right price to justify such long-term investment costs. Currently, the export option seems more viable than the domestic market questioning the Econometrix study’s claim of healthy domestic beneficiation. If shale-gas becomes a preferred option for export, and is available in large quantities, the export market will earn hard currency. The flow of dollars into the South Africa economy can boost the rand and affect the viability of other exports. Shale-gas may lead us to catch the Dutch disease. This resource curse needs careful scrutiny. Jobs gained on the one-side may mean job losses on the other side. The Econometrix study is poor on its analysis of net jobs gained versus net jobs lost measured against shale-gas impacts on other energy carriers and sectors. Again, a more robust approach would be to model different scenarios for gas exports versus domestic consumption over reasonable time periods for the domestic market to unfold based on different whole-sale price scenarios for shale-gas. Different price scenarios suggest different levels of domestic market penetration as shale-gas will have to compete with other energy carriers in terms of elasticity of demand. Only then can we draw fair conclusions about the level of jobs that can be created within the South Africa market. For now the Econometrix exercise can only be deemed as economic ‘evidence’ playing to the public gallery.

Conclusion

The intrinsic problem with Econometrix report is that it is speculation of the highest order presenting itself as fact based. Without an economically viable reserve estimate all the ambitious plans around shale-gas extraction are just conjecture. We can be sure that an undeveloped gas market in South Africa, with questionable productivity of shale-gas wells, places both the resource availability and economics in doubt. The environmental costs continue to weigh heavy. The Econometrix study will do well to factor in more robust scenarios and sensitivity tests than it has. It should take a closer look at well-head costs (inclusive of drilling and fracking costs), infrastructure costs for storage and transport of gas, and costs associated with mitigating various types of environmental risk. It has to consider other options of gas supply if there is to be a fair assessment of whether these options are more cost effective than extraction of shale-gas from the Karoo.